

## **AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application:

### **Listing of Claims:**

- 1           1.       (Previously Presented) A method of flow controlling InfiniBand  
2 receive traffic, comprising:
  - 3           maintaining a single memory structure for queuing InfiniBand traffic  
4 received via multiple virtual lanes and multiple queue pairs;  
5           identifying a first packet payload received via a first virtual lane and a first  
6 queue pair;  
7           determining whether the first payload can be stored in the memory  
8 structure without exceeding a portion of the memory structure allocated to the  
9 first virtual lane;  
10          determining whether the first payload can be stored in the memory  
11 structure without exceeding a portion of the memory structure allocated to the  
12 first queue pair;  
13          if storing the first payload in the memory structure would exceed said  
14 portion of the memory structure allocated to the first queue pair, determining  
15 whether the first queue pair is enabled to use a shared portion of the memory  
16 structure to store payloads of packets received via the first queue pair; and  
17          maintaining a second memory configured to store, for each of the multiple  
18 queue pairs that is active, one or more parameters associated with operation of  
19 said queue pair, wherein said parameters include:
    - 20               a maximum number of message credits advertisable by said queue  
21               pair;

22 a maximum number of memory structure buffers dedicated to  
23 storing payloads of packets received via said queue pair;  
24 an indicator configured to indicate whether said queue pair is  
25 enabled to use a set of shared memory structure buffers; and  
26 a number of shared memory structure buffers in said set of shared  
27 memory structure buffers, wherein said shared memory structure buffers  
28 are available for use by said queue pair to store payloads of packets  
29 received via said queue pair if:  
30 said queue pair has used said maximum number of memory  
31 structure buffers; and  
32 said indicator indicates that said queue pair is enabled to  
33 use said set of shared memory structure buffers; and  
34 a maximum number of message credits advertisable by said queue  
35 pair when said queue pair starts using said shared memory structure  
36 buffers.

1 2-10. (Cancelled)

1 11. (Previously Presented) A computer readable medium storing  
2 instructions that, when executed by a computer, cause the computer to perform a  
3 method of flow controlling InfiniBand receive traffic, the method comprising:  
4 maintaining a single memory structure for queuing InfiniBand traffic  
5 received via multiple virtual lanes and multiple queue pairs;  
6 identifying a first packet payload received via a first virtual lane and a first  
7 queue pair;  
8 determining whether the first payload can be stored in the memory  
9 structure without exceeding a portion of the memory structure allocated to the  
10 first virtual lane;

11           determining whether the first payload can be stored in the memory  
12   structure without exceeding a portion of the memory structure allocated to the  
13   first queue pair;  
14           if storing the first payload in the memory structure would exceed said  
15   portion of the memory structure allocated to the first queue pair, determining  
16   whether the first queue pair is enabled to use a shared portion of the memory  
17   structure to store payloads of packets received via the first queue pair; and  
18           maintaining a second memory configured to store, for each of the multiple  
19   queue pairs that is active, one or more parameters associated with operation of  
20   said queue pair, wherein said parameters include:  
21               a maximum number of message credits advertisable by said queue  
22   pair;  
23               a maximum number of memory structure buffers dedicated to  
24   storing payloads of packets received via said queue pair;  
25               an indicator configured to indicate whether said queue pair is  
26   enabled to use a set of shared memory structure buffers; and  
27               a number of shared memory structure buffers in said set of shared  
28   memory structure buffers, wherein said shared memory structure buffers  
29   are available for use by said queue pair to store payloads of packets  
30   received via said queue pair if:  
31                   said queue pair has used said maximum number of memory  
32   structure buffers; and  
33                   said indicator indicates that said queue pair is enabled to  
34   use said set of shared memory structure buffers; and  
35               a maximum number of message credits advertisable by said queue  
36   pair when said queue pair starts using said shared memory structure  
37   buffers.

1           12-29. (Cancelled)

1           30.     (Previously Presented) A method of avoiding locking, in receive  
2     InfiniBand queues, the method comprising:  
3           maintaining a single memory structure for reassembling InfiniBand traffic  
4     received via multiple virtual lanes and multiple queue pairs;  
5           identifying a first packet payload received via a first queue pair that is  
6     idle, wherein the first queue pair is considered idle if no traffic from the first  
7     queue pair is stored in said single memory structure;  
8           for each other queue pair for which traffic from said queue pair is stored in  
9     said single memory structure, determining whether sufficient space in the single  
10    memory structure is reserved for reassembling said traffic;  
11          storing the first packet payload in said single memory structure only if  
12    sufficient space in the single memory structure is available for reassembling said  
13    traffic; and  
14          maintaining a second memory configured to store, for each of the multiple  
15    queue pairs that is active, one or more parameters associated with operation of  
16    said queue pair, wherein said parameters include:  
17                  a maximum number of message credits advertisable by said queue  
18                  pair;  
19                  a maximum number of memory structure buffers dedicated to  
20                  storing payloads of packets received via said queue pair;  
21                  an indicator configured to indicate whether said queue pair is  
22                  enabled to use a set of shared memory structure buffers; and  
23                  a number of shared memory structure buffers in said set of shared  
24                  memory structure buffers, wherein said shared memory structure buffers  
25                  are available for use by said queue pair to store payloads of packets  
26                  received via said queue pair if:

27                               said queue pair has used said maximum number of memory  
28                               structure buffers; and  
29                               said indicator indicates that said queue pair is enabled to  
30                               use said set of shared memory structure buffers; and  
31                               a maximum number of message credits advertisable by said queue  
32                               pair when said queue pair starts using said shared memory structure  
33                               buffers.

1               31.     (Cancelled)

1               32.     (Previously Presented) An apparatus for flow controlling received  
2     InfiniBand traffic, comprising:  
3               a single memory structure configured to queue payloads of InfiniBand  
4     traffic received via multiple virtual lanes and multiple queue pairs;  
5               a resource manager configured to manage the memory structure;  
6               a first module configured to facilitate the advertisement of virtual lane  
7     credits;  
8               a second module configured to facilitate the advertisement of queue pair  
9     credits; and  
10              a second memory configured to store, for each of the multiple queue pairs  
11     that is active, one or more parameters associated with operation of said queue  
12     pair, wherein said parameters include:  
13              a maximum number of message credits advertisable by said queue  
14     pair;  
15              a maximum number of memory structure buffers dedicated to  
16     storing payloads of packets received via said queue pair;  
17              an indicator configured to indicate whether said queue pair is  
18     enabled to use a set of shared memory structure buffers; and

19 a number of shared memory structure buffers in said set of shared  
20 memory structure buffers, wherein said shared memory structure buffers  
21 are available for use by said queue pair to store payloads of packets  
22 received via said queue pair if:  
23 said queue pair has used said maximum number of memory  
24 structure buffers; and  
25 said indicator indicates that said queue pair is enabled to  
26 use said set of shared memory structure buffers; and  
27 a maximum number of message credits advertisable by said queue  
28 pair when said queue pair starts using said shared memory structure  
29 buffers.

1 33-55. (Cancelled)

1 56. (New) A method of flow controlling InfiniBand receive traffic,  
2 comprising:  
3 maintaining a single memory structure for queuing InfiniBand traffic  
4 received via multiple virtual lanes and multiple queue pairs;  
5 maintaining a second memory configured to store, for each of the multiple  
6 queue pairs that is active, one or more parameters associated with operation of  
7 said queue pair, wherein said parameters include a maximum number of message  
8 credits advertisable by said queue pair;  
9 identifying a first packet payload received via a first virtual lane and a first  
10 queue pair;  
11 determining whether the first payload can be stored in the memory  
12 structure without exceeding a portion of the memory structure allocated to the  
13 first virtual lane;  
14 determining whether the first payload can be stored in the memory

15 structure without exceeding a portion of the memory structure allocated to the  
16 first queue pair; and  
17 if storing the first payload in the memory structure would exceed said  
18 portion of the memory structure allocated to the first queue pair, determining  
19 whether the first queue pair is enabled to use a shared portion of the memory  
20 structure to store payloads of packets received via the first queue pair.

1 57. (New) The method of claim 56, wherein the second memory is  
2 further configured to store one or more additional parameters associated with  
3 operation of said queue pair, wherein said additional parameters include:  
4 a maximum number of memory structure buffers dedicated to storing  
5 payloads of packets received via said queue pair;  
6 an indicator configured to indicate whether said queue pair is enabled to  
7 use a set of shared memory structure buffers; and  
8 a number of shared memory structure buffers in said set of shared memory  
9 structure buffers, wherein said shared memory structure buffers are available for  
10 use by said queue pair to store payloads of packets received via said queue pair if:  
11 said queue pair has used said maximum number of memory  
12 structure buffers; and  
13 said indicator indicates that said queue pair is enabled to use said  
14 set of shared memory structure buffers; and  
15 a maximum number of message credits advertisable by said queue  
16 pair when said queue pair starts using said shared memory structure  
17 buffers.

1 58. (New) The method of claim 56, further comprising:  
2 allocating a portion of the memory structure to each of the multiple virtual  
3 lanes; and

4 allocating a portion of the memory structure to each of the multiple queue  
5 pairs.

1 59. (New) The method of claim 56, wherein the memory structure  
2 comprises a set of linked lists of memory structure buffers, including one linked  
3 list for each of the multiple queue pairs that are active.

1 60. (New) The method of claim 56, further comprising:  
2 dropping the first payload if the first payload cannot be stored in the  
3 memory structure without exceeding the portion of the memory structure  
4 allocated to the first virtual lane.

1 61. (New) The method of claim 56, further comprising:  
2 issuing a Retry, Not Ready, Negative Acknowledgement (RNR-NAK) if:  
3 the first payload cannot be stored in the memory structure without  
4 exceeding a portion of the memory structure allocated to the first queue  
5 pair; and  
6 the first queue pair is not enabled to use the shared portion of the  
7 memory structure.

1 62. (New) The method of claim 56, further comprising:  
2 issuing a Retry, Not Ready, Negative Acknowledgement (RNR-NAK) if:  
3 the first payload cannot be stored in the memory structure without  
4 exceeding a portion of the memory structure allocated to the first queue  
5 pair;  
6 the first queue pair is enabled to use the shared portion of the  
7 memory structure; and  
8 the shared portion of the memory structure is full.



1           63.     (New) The method of claim 56, further comprising:  
2           defining one or more dedicated thresholds in the portion of the memory  
3           structure allocated to the first queue pair; and  
4           for each of said dedicated thresholds, identifying a number of message  
5           credits the queue pair may advertise when the amount of the memory structure  
6           used by the queue pair exceeds said dedicated threshold.

1           64.     (New) The method of claim 56, further comprising:  
2           defining one or more shared thresholds in the shared portion of the  
3           memory structure; and  
4           for each of said shared thresholds, identifying a number of message credits  
5           the queue pair may advertise when the amount of the shared portion used by the  
6           multiple queue pairs exceeds said shared threshold.

1           65.     (New) The method of claim 56, further comprising:  
2           receiving a request on a second queue pair to perform an RDMA (Remote  
3           Direct Memory Access) Read operation; and  
4           based on an amount of data expected to be received via the RDMA Read  
5           operation, reserving a sufficient number of buffers in the memory structure.

1           66.     (New) The method of claim 56, further comprising:  
2           in the single memory structure, reassembling the queued InfiniBand traffic  
3           into outbound communications;  
4           receiving a payload on an idle queue pair, wherein a queue pair is idle if  
5           no traffic from the queue pair is stored in the single memory structure; and  
6           only queuing the payload in the single memory structure if sufficient space  
7           in the single memory structure is reserved for completing reassembly of outbound  
8           communications on each non-idle queue pair.

1           67.     (New) A computer readable medium storing instructions that,  
2     when executed by a computer, cause the computer to perform a method of flow  
3     controlling InfiniBand receive traffic, the method comprising:  
4           maintaining a single memory structure for queuing InfiniBand traffic  
5     received via multiple virtual lanes and multiple queue pairs;  
6           maintaining a second memory configured to store, for each of the multiple  
7     queue pairs that is active, one or more parameters associated with operation of  
8     said queue pair, wherein said parameters include a maximum number of message  
9     credits advertisable by said queue pair;  
10          identifying a first packet payload received via a first virtual lane and a first  
11     queue pair;  
12          determining whether the first payload can be stored in the memory  
13     structure without exceeding a portion of the memory structure allocated to the  
14     first virtual lane;  
15          determining whether the first payload can be stored in the memory  
16     structure without exceeding a portion of the memory structure allocated to the  
17     first queue pair; and  
18          if storing the first payload in the memory structure would exceed said  
19     portion of the memory structure allocated to the first queue pair, determining  
20     whether the first queue pair is enabled to use a shared portion of the memory  
21     structure to store payloads of packets received via the first queue pair.

1           68.     (New) The computer readable medium of claim 67, wherein the  
2     second memory is further configured to store one or more additional parameters  
3     associated with operation of said queue pair, wherein said additional parameters  
4     include:  
5           a maximum number of memory structure buffers dedicated to storing  
6     payloads of packets received via said queue pair;

7           an indicator configured to indicate whether said queue pair is enabled to  
8    use a set of shared memory structure buffers; and  
9           a number of shared memory structure buffers in said set of shared memory  
10   structure buffers, wherein said shared memory structure buffers are available for  
11   use by said queue pair to store payloads of packets received via said queue pair if:  
12           said queue pair has used said maximum number of memory  
13    structure buffers; and  
14           said indicator indicates that said queue pair is enabled to use said  
15    set of shared memory structure buffers; and  
16           a maximum number of message credits advertisable by said queue pair  
17   when said queue pair starts using said shared memory structure buffers.

1           69.   (New) The computer readable medium of claim 67, wherein the  
2   method further comprises:  
3           defining one or more dedicated thresholds in the portion of the memory  
4   structure allocated to the first queue pair; and  
5           for each of said dedicated thresholds, identifying a number of message  
6   credits the queue pair may advertise when the amount of the memory structure  
7   used by the queue pair exceeds said dedicated threshold.

1           70.   (New) The computer readable medium of claim 67, wherein the  
2   method further comprises:  
3           defining one or more shared thresholds in the shared portion of the  
4   memory structure; and  
5           for each of said shared thresholds, identifying a number of message credits  
6   the queue pair may advertise when the amount of the shared portion used by the  
7   multiple queue pairs exceeds said shared threshold.

1           71.     (New) The computer readable medium of claim 67, wherein the  
2 method further comprises issuing a Retry, Not Ready, Negative  
3 Acknowledgement (RNR-NAK) only if one of:

4           (a)     the first payload cannot be stored in the memory structure without  
5           exceeding a portion of the memory structure allocated to the first queue  
6           pair; and

7                   the first queue pair is not enabled to use the shared portion of the  
8           memory structure; and

9           (b)     the first payload cannot be stored in the memory structure without  
10           exceeding a portion of the memory structure allocated to the first queue  
11           pair;

12                   the first queue pair is enabled to use the shared portion of the  
13           memory structure; and

14                   the shared portion of the memory structure is full.

1           72.     (New) A method of avoiding locking in receive InfiniBand queues,  
2 the method comprising:

3           maintaining a single memory structure for reassembling InfiniBand traffic  
4 received via multiple virtual lanes and multiple queue pairs;

5           maintaining a second memory configured to store, for each of the multiple  
6 queue pairs that is active, one or more parameters associated with operation of  
7 said queue pair, wherein said parameters include a maximum number of message  
8 credits advertisable by said queue pair;

9           identifying a first packet payload received via a first queue pair that is  
10 idle, wherein the first queue pair is considered idle if no traffic from the first  
11 queue pair is stored in said single memory structure;

12                   for each other queue pair for which traffic from said queue pair is stored in  
13 said single memory structure, determining whether sufficient space in the single

14 memory structure is reserved for reassembling said traffic; and  
15 storing the first packet payload in said single memory structure only if  
16 sufficient space in the single memory structure is available for reassembling said  
17 traffic.

1 73. (New) The method of claim 72, wherein the second memory is  
2 further configured to store one or more additional parameters associated with  
3 operation of said queue pair, wherein said additional parameters include:  
4 a maximum number of memory structure buffers dedicated to storing  
5 payloads of packets received via said queue pair;  
6 an indicator configured to indicate whether said queue pair is enabled to  
7 use a set of shared memory structure buffers; and  
8 a number of shared memory structure buffers in said set of shared memory  
9 structure buffers, wherein said shared memory structure buffers are available for  
10 use by said queue pair to store payloads of packets received via said queue pair if:  
11 said queue pair has used said maximum number of memory  
12 structure buffers; and  
13 said indicator indicates that said queue pair is enabled to use said  
14 set of shared memory structure buffers; and  
15 a maximum number of message credits advertisable by said queue  
16 pair when said queue pair starts using said shared memory structure  
17 buffers.

1 74. (Original) The method of claim 72, wherein said determining  
2 comprises, for each said other queue pair:  
3 identifying an amount of space in said single memory structure reserved  
4 for said other queue pair; and  
5 comparing said amount of reserved space to an amount of space expected

6 to be needed to complete reassembly of said traffic from said other queue pair.

1           75.     (New) An apparatus for flow controlling received InfiniBand  
2 traffic, comprising:  
3           a single memory structure configured to queue payloads of InfiniBand  
4 traffic received via multiple virtual lanes and multiple queue pairs;  
5           a second memory configured to store, for each of the multiple queue pairs  
6 that is active, one or more parameters associated with operation of said queue  
7 pair, wherein said parameters include a maximum number of message credits  
8 advertisable by said queue pair;  
9           a resource manager configured to manage the memory structure;  
10          a first module configured to facilitate the advertisement of virtual lane  
11 credits;  
12          a second module configured to facilitate the advertisement of queue pair  
13 credits.

1           76.     (New) The apparatus of claim 75, wherein the second memory is  
2 further configured to store one or more additional parameters associated with  
3 operation of said queue pair, wherein said additional parameters include:  
4           a maximum number of memory structure buffers dedicated to storing  
5 payloads of packets received via said queue pair;  
6           an indicator configured to indicate whether said queue pair is enabled to  
7 use a set of shared memory structure buffers; and  
8           a number of shared memory structure buffers in said set of shared memory  
9 structure buffers, wherein said shared memory structure buffers are available for  
10 use by said queue pair to store payloads of packets received via said queue pair if:  
11           said queue pair has used said maximum number of memory  
12           structure buffers; and

13                   said indicator indicates that said queue pair is enabled to use said  
14           set of shared memory structure buffers; and  
15                   a maximum number of message credits advertisable by said queue  
16           pair when said queue pair starts using said shared memory structure  
17           buffers.

1           77.     (New) The apparatus of claim 75, wherein said single memory  
2           structure comprises multiple linked lists of memory structure buffers, including  
3           one linked list for each of the multiple queue pairs that is active.

1           78.     (New) The apparatus of claim 75, wherein said first module  
2           comprises an InfiniBand link core.

1           79.     (New) The apparatus of claim 75, wherein said second module  
2           comprises an acknowledgement generator configured to generate transport layer  
3           acknowledgements.

1           80.     (New) The apparatus of claim 75, further comprising a processor  
2           interface configured to facilitate the programming of operating parameters  
3           associated with the multiple virtual lanes and the multiple queue pairs.

1           81.     (New) The apparatus of claim 75, further comprising:  
2           a first memory configured to store one or more parameters associated with  
3           operation of a first virtual lane.

1           82.     (New) The apparatus of claim 81, wherein said one or more  
2           parameters include:  
3           a count of the number of memory structure buffers currently used to store

4 payloads of packets received via the first virtual lane; and  
5 a threshold, wherein a first packet is dropped if storing the payload of the  
6 first packet would cause said count to exceed said threshold.

1 83. (New) The apparatus of claim 75, wherein said one or more  
2 parameters further include:  
3 one or more dedicated thresholds, wherein each said dedicated threshold  
4 identifies a subset of said maximum number of memory structure buffers; and  
5 for each said dedicated threshold, a number of message credits  
6 advertisable by said queue pair when said queue pair uses said subset of said  
7 maximum number of memory structure buffers.

1 84. (New) The apparatus of claim 75, wherein said one or more  
2 parameters further include:  
3 one or more shared thresholds, wherein each said shared threshold  
4 identifies a subset of said number of shared memory structure buffers; and  
5 for each said shared threshold, a number of message credits advertisable  
6 by said queue pair when said queue pair uses said subset of said number of shared  
7 memory structure buffers.